

Εθνικό Μετσόβιο Πολυτεχνείο

Σχολή Μηχανολόγων Μηχανικών

Τομέας Μηχανολογικών Κατασκευών και Αυτομάτου Ελέγχου

Εργαστήριο Εμβιομηχανικής και Συστημικής Βιολογίας

Εμβιομηχανική και Βιοϊατρική Τεχνολογία

**OPTIMIZATION OF ODE-BASED MODEL FOR MONITORING SIGNALING TRASDUCTION ACTIVITY IN HEPATOCYTES**

Επώνυμο: Μαυράκης

Όνομα: Ευάγγελος

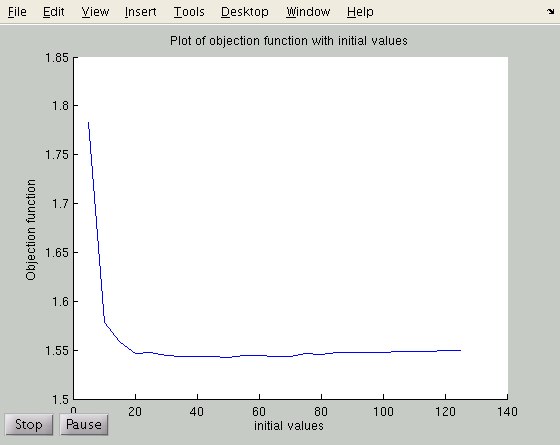
Κατεύθυνση: Κατασκευαστής

Παρουσίαση αποτελεσμάτων

Για κάθε έναν Inhibitor (4D)(1:DMSO, 2:MEK, 3:PI3K, 4:MEK-PI3K, 5:EGF, 6:EGF-MEK-PI3K), κάνω πολλές βελτιστοποιήσεις, μία για κάθε αρχική συνθήκη και βλέπω συνολικά πότε η αντικειμενική συνάρτηση είναι η μικρότερη. Σε κάθε μία βελτιστοποίηση βρίσκω τα x1, x2 και η αντικειμενική συνάρτηση είναι το άθροισμα των απολύτων τιμών των διαφορών της υπολογισμένης καμπύλης ERK12 με την πειραματική στα συγκεκριμένα σημεία. Το συνολικό άθροισμα είναι σε όλες τις Cytokines(3D) (2:EGF, 6:INS-EGF, 7:EGF-HGF, 8:HER-EGF, 11:INS-EGF-HGF) με διεγέρτη την MEK1.

**Inhibitor: DMSO**

Interior-point

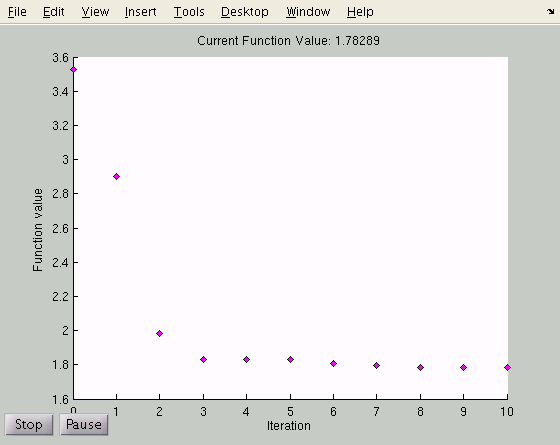


min(f) = 1.5424 και i = 10, xo = [50, 50], xopt = [56.0742, 43.4277]

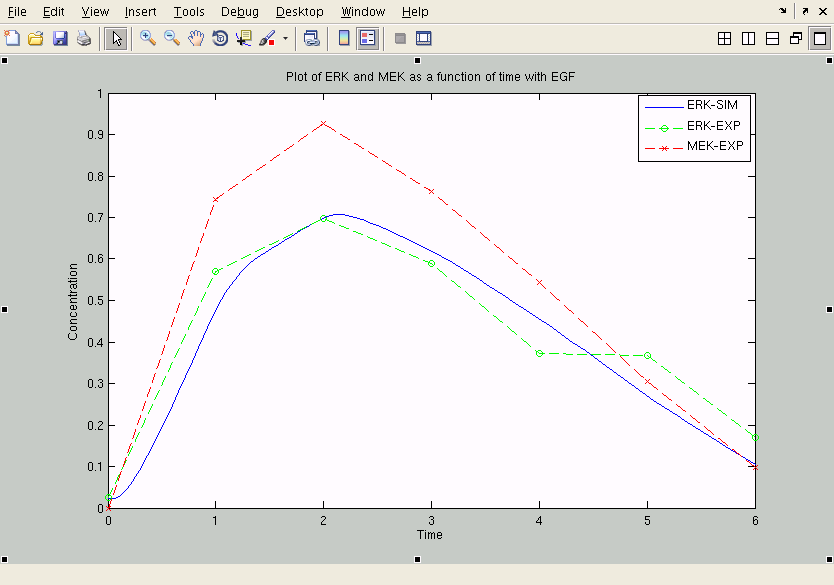
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 5.6201 | 4.3950 | 1.7829 |
| 10 | 11.3926 | 8.7920 | 1.5782 |
| 15 | 17.0625 | 13.0312 | 1.5591 |
| 20 | 22.5781 | 17.2422 | 1.5463 |
| 25 | 28.4814 | 21.9800 | 1.5475 |
| 30 | 34.1016 | 26.1445 | 1.5449 |
| 35 | 39.2656 | 30.1328 | 1.5439 |
| 40 | 45.2656 | 34.8203 | 1.5437 |
| 45 | 50.9238 | 39.1729 | 1.5433 |
| 50 | 56.0742 | 43.4277 | 1.5424 |
| 55 | 62.2188 | 48.2969 | 1.5446 |
| 60 | 67.8164 | 52.3301 | 1.5445 |
| 65 | 73.5478 | 56.6909 | 1.5438 |
| 70 | 79.1191 | 61.0518 | 1.5435 |
| 75 | 84.1406 | 64.5703 | 1.5467 |
| 80 | 90.9375 | 69.7188 | 1.5460 |
| 85 | 96.0732 | 74.1343 | 1.5475 |
| 90 | 101.7246 | 78.4951 | 1.5480 |
| 95 | 106.5781 | 81.7891 | 1.5471 |
| 100 | 112.1875 | 86.0938 | 1.5481 |
| 105 | 117.7969 | 90.3984 | 1.5481 |
| 110 | 125.0391 | 95.8633 | 1.5489 |
| 115 | 129.0156 | 99.0078 | 1.5489 |
| 120 | 134.6250 | 103.3125 | 1.5493 |
| 125 | 140.2344 | 107.6172 | 1.5496 |

Γράφημα για x = [5.6201, 4.3950]

Σύγκλιση

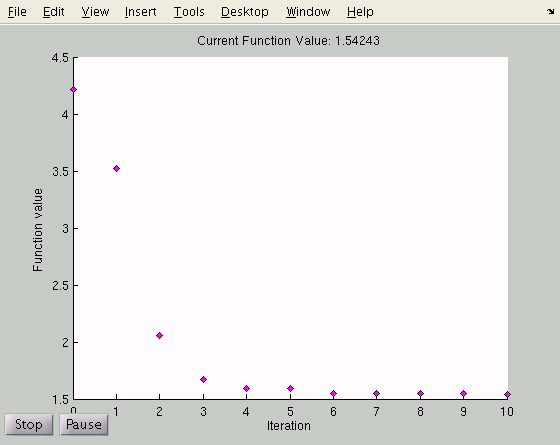


Λύση

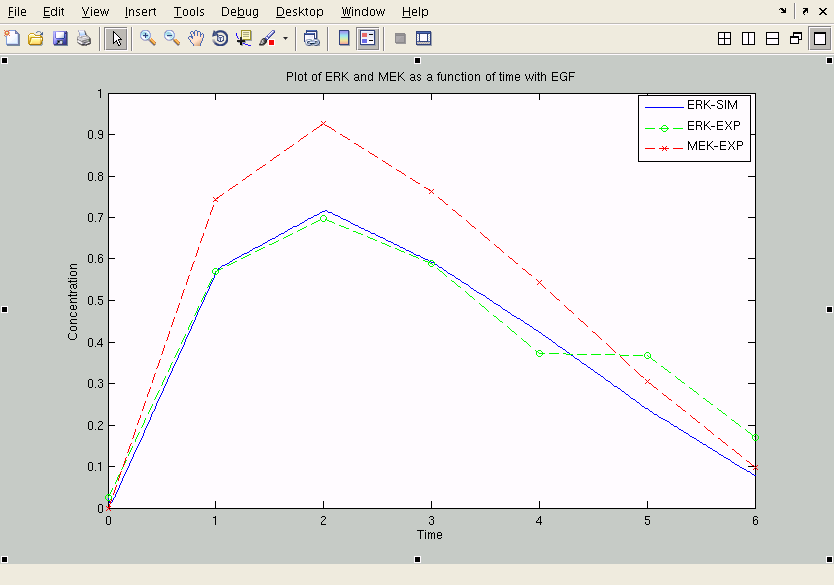


Γράφημα για x = [56.0742, 43.4277]

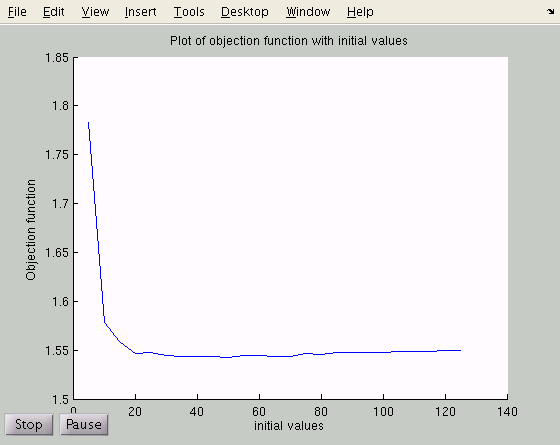
Σύγκλιση



Λύση



SQP

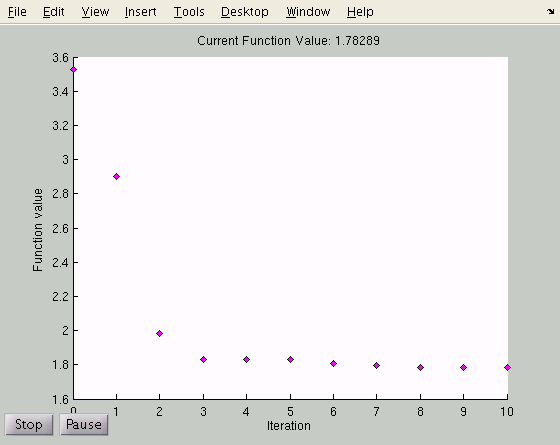


min(f) = 1.5424 και i = 10, xo = [50, 50], xopt = [56.0742, 43.4277]

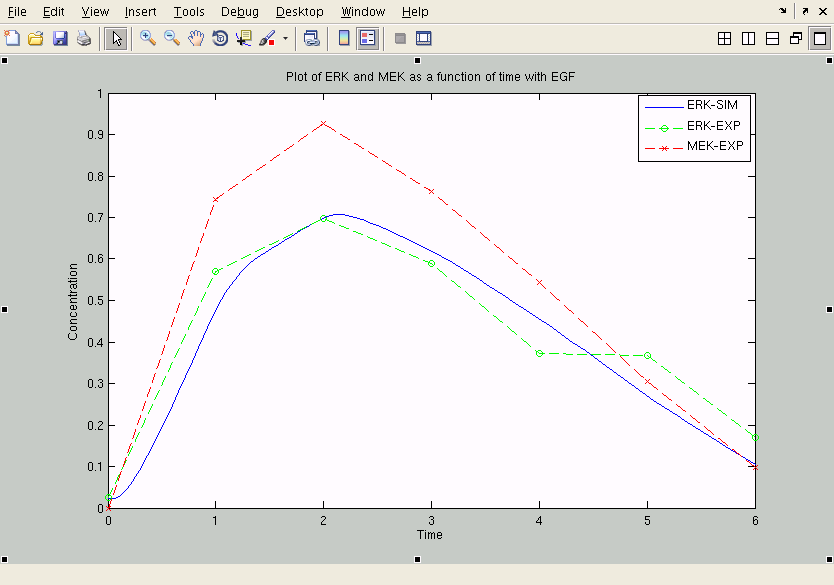
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 5.6201 | 4.3950 | 1.7829 |
| 10 | 11.3926 | 8.7920 | 1.5782 |
| 15 | 17.0625 | 13.0312 | 1.5591 |
| 20 | 22.5781 | 17.2422 | 1.5463 |
| 25 | 28.4814 | 21.9800 | 1.5475 |
| 30 | 34.1016 | 26.1445 | 1.5449 |
| 35 | 39.2656 | 30.1328 | 1.5439 |
| 40 | 45.2656 | 34.8203 | 1.5437 |
| 45 | 50.9238 | 39.1729 | 1.5433 |
| 50 | 56.0742 | 43.4277 | 1.5424 |
| 55 | 62.2188 | 48.2969 | 1.5446 |
| 60 | 67.8164 | 52.3301 | 1.5445 |
| 65 | 73.4678 | 56.6909 | 1.5438 |
| 70 | 79.1191 | 61.0518 | 1.5435 |
| 75 | 84.1406 | 64.5703 | 1.5467 |
| 80 | 90.9375 | 69.7188 | 1.5460 |
| 85 | 96.0732 | 74.1343 | 1.5475 |
| 90 | 101.7246 | 78.4951 | 1.5480 |
| 95 | 106.5781 | 81.7891 | 1.5471 |
| 100 | 112.1875 | 86.0938 | 1.5481 |
| 105 | 117.7969 | 90.3984 | 1.5481 |
| 110 | 125.0391 | 95.8633 | 1.5489 |
| 115 | 129.0156 | 99.0078 | 1.5489 |
| 120 | 134.6250 | 103.3125 | 1.5493 |
| 125 | 140.2344 | 107.6172 | 1.5496 |

Γράφημα για x = [5.6201, 4.3950]

Σύγκλιση

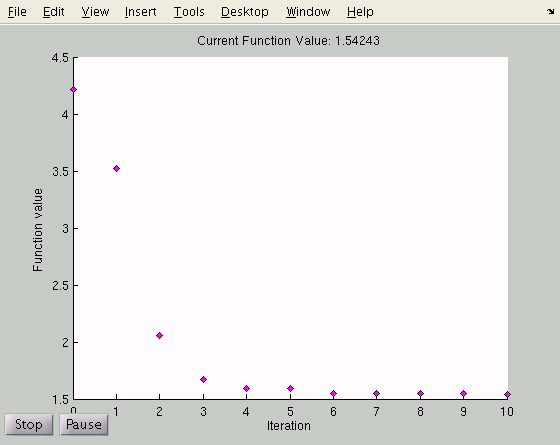


Λύση

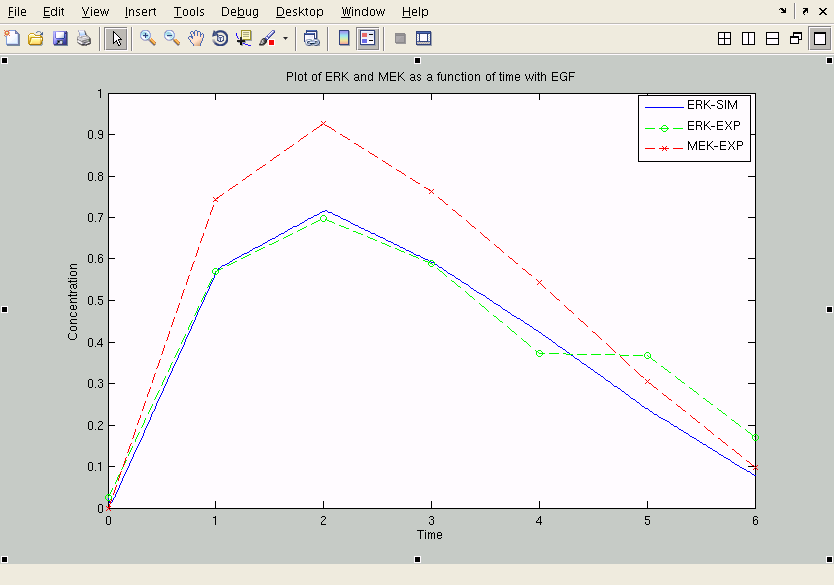


Γράφημα για x = [56.0742, 43.4277]

Σύγκλιση

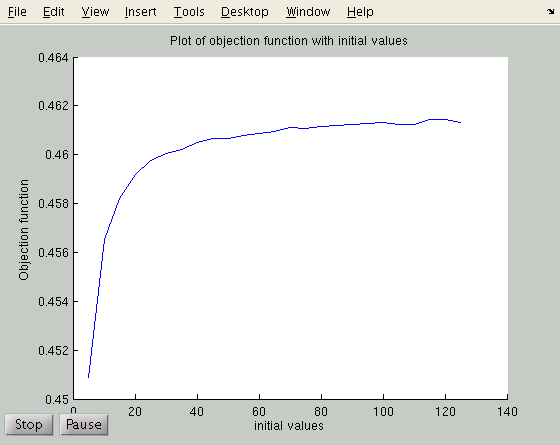


Λύση



**Inhibitor: MEK**

Interior point

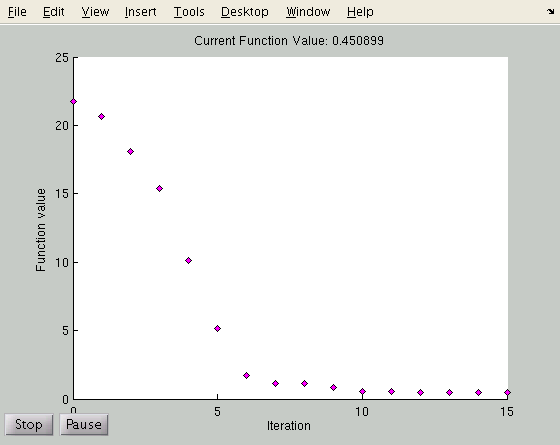


Min(f) = 0.4509, i = 1, xo = [5,5], xopt = [9.0935, 0.2432]

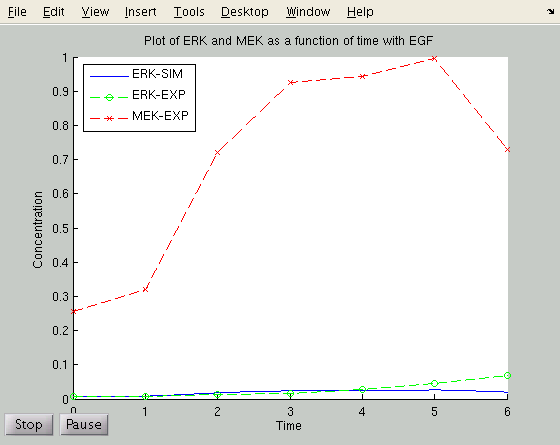
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 9.0935 | 0.2432 | 0.4509 |
| 10 | 18.1870 | 0.4863 | 0.4565 |
| 15 | 27.2805 | 0.7295 | 0.4582 |
| 20 | 36.3740 | 0.9727 | 0.4592 |
| 25 | 45.4675 | 1.2158 | 0.4597 |
| 30 | 54.5610 | 1.4590 | 0.4600 |
| 35 | 63.6545 | 1.7021 | 0.4602 |
| 40 | 72.7480 | 1.9453 | 0.4605 |
| 45 | 81.8416 | 2.1885 | 0.4606 |
| 50 | 90.9351 | 2.4316 | 0.4607 |
| 55 | 100.0286 | 2.6748 | 0.4608 |
| 60 | 109.1221 | 2.9180 | 0.4609 |
| 65 | 118.2156 | 3.1611 | 0.4610 |
| 70 | 127.3091 | 3.4043 | 0.4611 |
| 75 | 136.4026 | 3.6475 | 0.4611 |
| 80 | 145.4961 | 3.8906 | 0.4611 |
| 85 | 154.5896 | 4.1338 | 0.4612 |
| 90 | 163.6831 | 4.3770 | 0.4612 |
| 95 | 172.7766 | 4.6201 | 0.4613 |
| 100 | 181.8701 | 4.8633 | 0.4613 |
| 105 | 190.9636 | 5.1064 | 0.4612 |
| 110 | 200.0571 | 5.3496 | 0.4613 |
| 115 | 209.1506 | 5.5928 | 0.4615 |
| 120 | 218.2441 | 5.8359 | 0.4614 |
| 125 | 227.3376 | 6.0791 | 0.4613 |

Γράφημα για x = [9.0935, 0.2432]

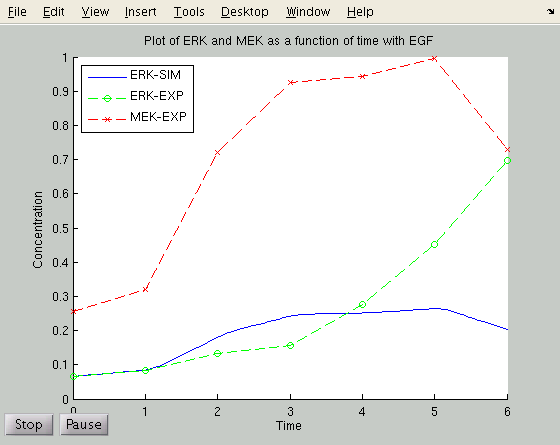
Σύγκλιση



Λύση

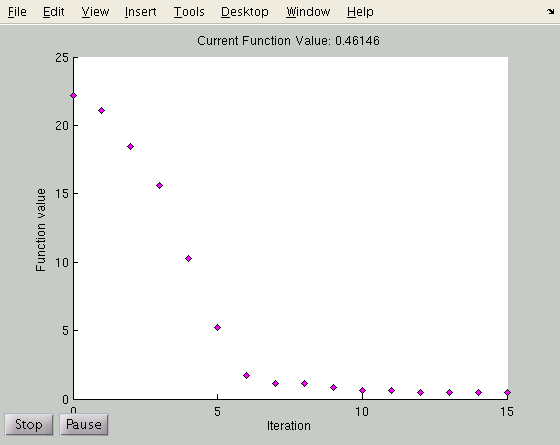


ERK\*10 (για να φαίνεται)

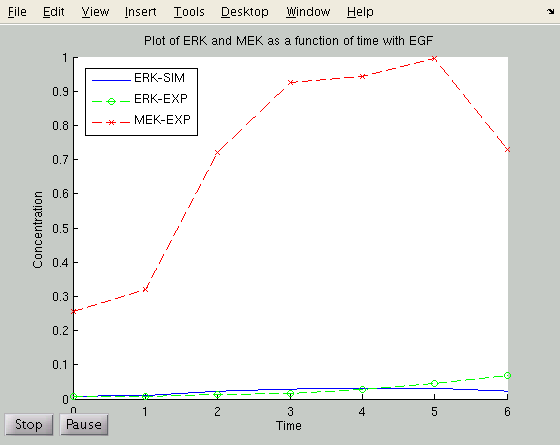


Γράφημα για x = [227.3376, 6.0791]

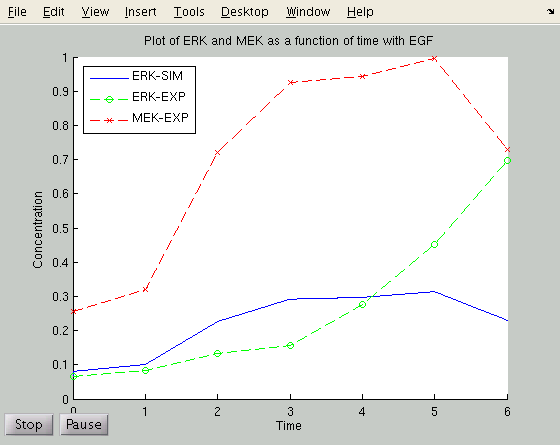
Σύγκλιση



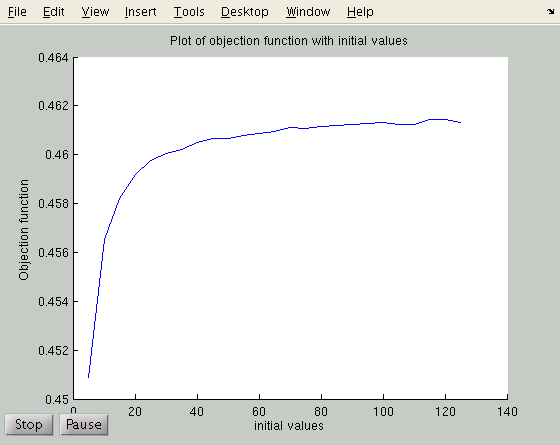
Λύση



ERK\*10 για να φαίνεται



SQP

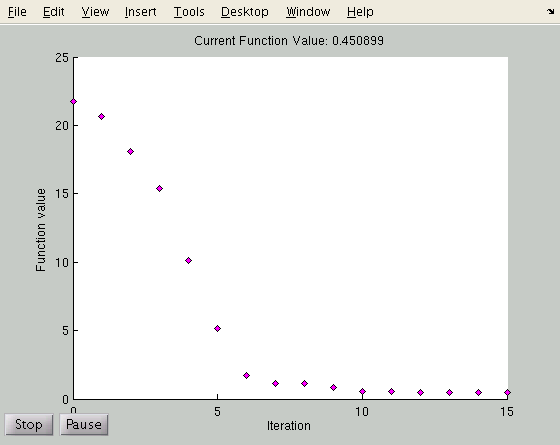


Min(f) = 0.4509, i = 1, xo = [5,5], xopt = [9.0935, 0.2432]

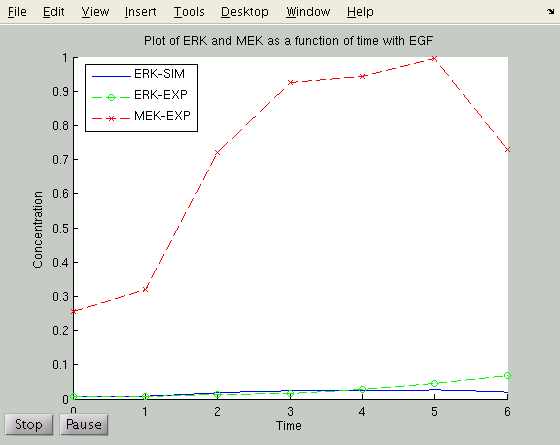
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 9.0935 | 0.2432 | 0.4509 |
| 10 | 18.1870 | 0.4863 | 0.4565 |
| 15 | 27.2805 | 0.7295 | 0.4582 |
| 20 | 36.3740 | 0.9727 | 0.4592 |
| 25 | 45.4675 | 1.2158 | 0.4597 |
| 30 | 54.5610 | 1.4590 | 0.4600 |
| 35 | 63.6545 | 1.7021 | 0.4602 |
| 40 | 72.7480 | 1.9453 | 0.4605 |
| 45 | 81.8416 | 2.1885 | 0.4606 |
| 50 | 90.9351 | 2.4316 | 0.4607 |
| 55 | 100.0286 | 2.6748 | 0.4608 |
| 60 | 109.1221 | 2.9180 | 0.4609 |
| 65 | 118.2156 | 3.1611 | 0.4610 |
| 70 | 127.3091 | 3.4043 | 0.4611 |
| 75 | 136.4026 | 3.6475 | 0.4611 |
| 80 | 145.4961 | 3.8906 | 0.4611 |
| 85 | 154.5896 | 4.1338 | 0.4612 |
| 90 | 163.6831 | 4.3770 | 0.4612 |
| 95 | 172.7766 | 4.6201 | 0.4613 |
| 100 | 181.8701 | 4.8633 | 0.4613 |
| 105 | 190.9636 | 5.1064 | 0.4612 |
| 110 | 200.0571 | 5.3496 | 0.4613 |
| 115 | 209.1506 | 5.5928 | 0.4615 |
| 120 | 218.2441 | 5.8359 | 0.4614 |
| 125 | 227.3376 | 6.0791 | 0.4613 |

Γράφημα για x = [9.0935, 0.2432]

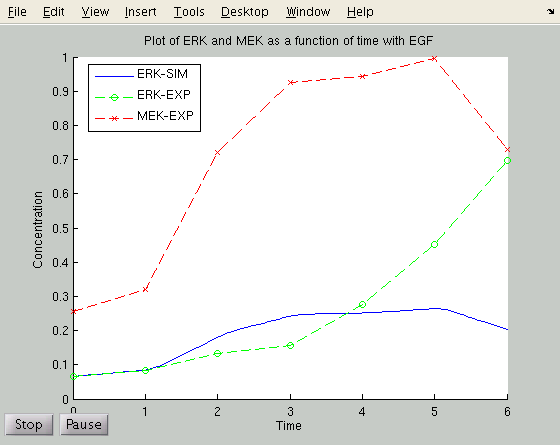
Σύγκλιση



Λύση

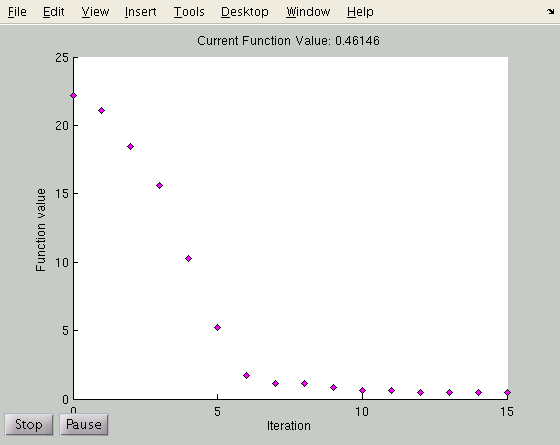


ERK\*10 για να φαίνεται

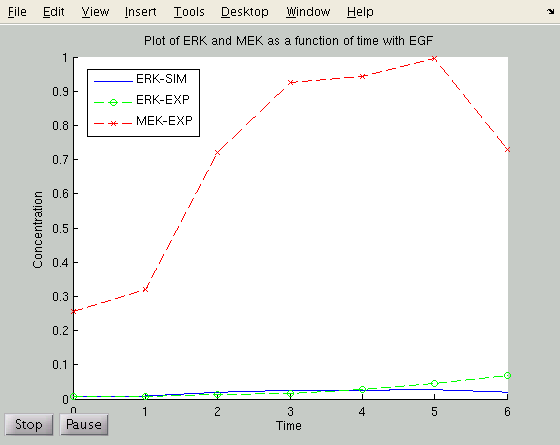


Γράφημα για x = [227.3376, 6.0791]

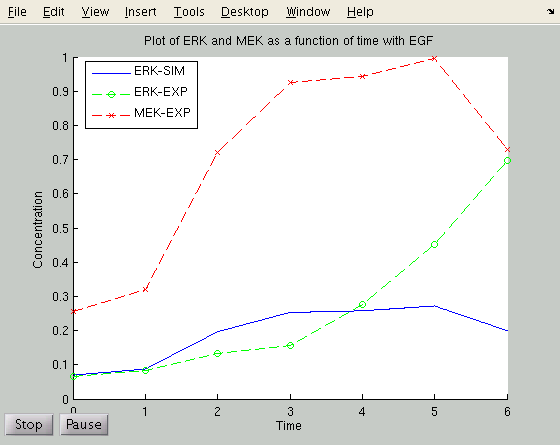
Σύγκλιση



Λύση

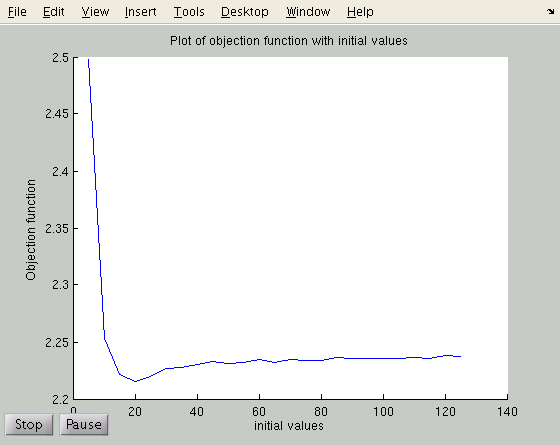


ERK\*10 για να φαίνεται



**Inhibitor: PI3K**

Interior point

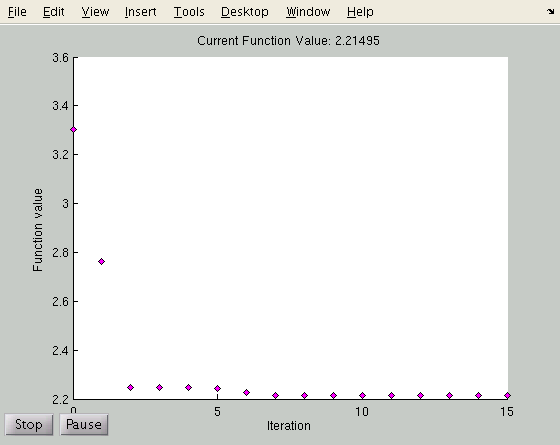


Min(f) = 0.2149, i = 4, xo = [20,20], xopt = [22.0004, 18.7272]

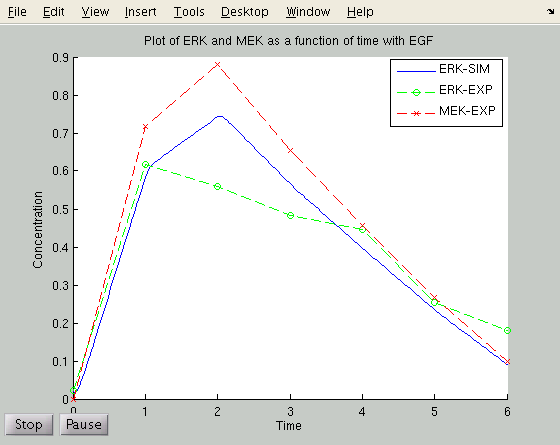
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 5.4514 | 4.5563 | 2.4979 |
| 10 | 10.5698 | 9.0774 | 2.2533 |
| 15 | 15.5024 | 13.2883 | 2.2216 |
| 20 | 22.0004 | 18.7272 | 2.2149 |
| 25 | 27.0102 | 22.7655 | 2.2197 |
| 30 | 32.0215 | 27.0117 | 2.2268 |
| 35 | 38.1266 | 31.8333 | 2.2273 |
| 40 | 43.8398 | 36.3672 | 2.2303 |
| 45 | 48.4724 | 40.2970 | 2.2330 |
| 50 | 54.7534 | 45.3271 | 2.2315 |
| 55 | 60.3515 | 49.9027 | 2.2322 |
| 60 | 65.6898 | 54.2175 | 2.2347 |
| 65 | 72.0962 | 59.3388 | 2.2322 |
| 70 | 76.3549 | 62.8445 | 2.2344 |
| 75 | 84.1333 | 69.0088 | 2.2337 |
| 80 | 87.0991 | 71.4873 | 2.2336 |
| 85 | 91.8440 | 75.2466 | 2.2336 |
| 90 | 97.6344 | 80.1497 | 2.2359 |
| 95 | 103.6550 | 84.8236 | 2.2356 |
| 100 | 110.2490 | 90.2637 | 2.2353 |
| 105 | 113.9440 | 93.3157 | 2.2356 |
| 110 | 117.1006 | 95.8418 | 2.2361 |
| 115 | 126.3751 | 103.4523 | 2.2359 |
| 120 | 130.4919 | 106.8003 | 2.2380 |
| 125 | 135.6277 | 110.9772 | 2.2372 |

Γράφημα για x = [22.0004, 18.7272]

Σύγκλιση

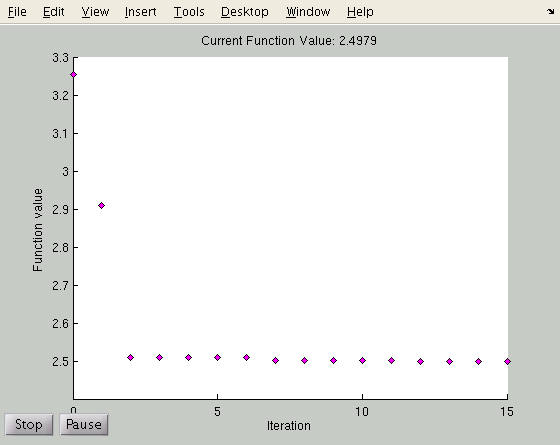


Λύση

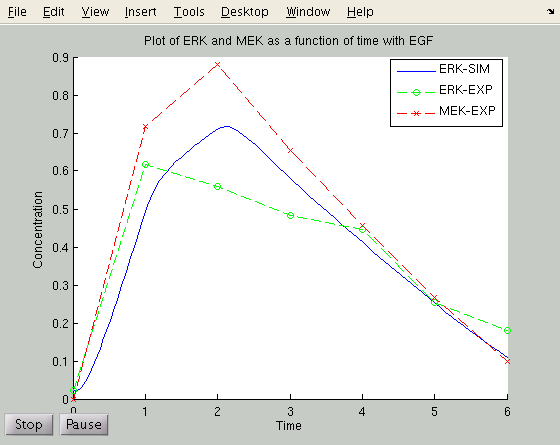


Γράφημα για x = [5.4514, 4.5563]

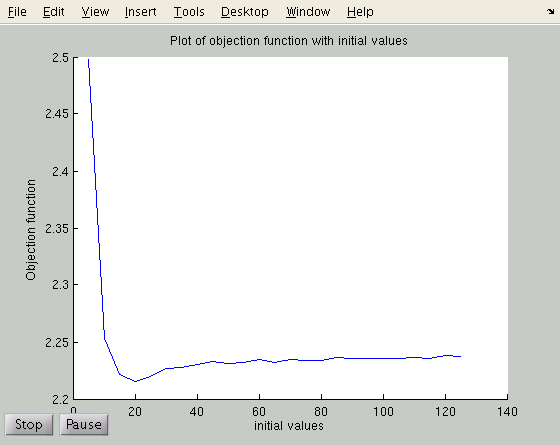
Σύγκλιση



Λύση



SQP

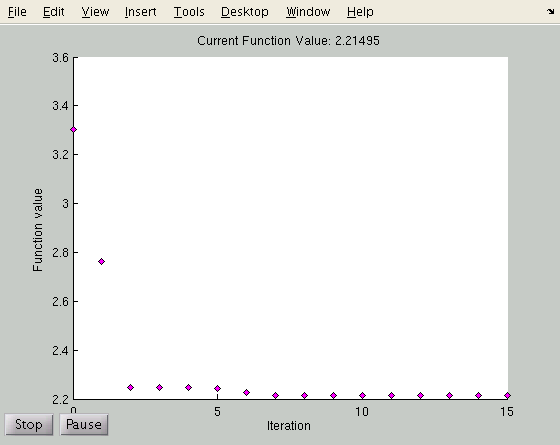


Min(f) = 0.2149, i = 4, xo = [20,20], xopt = [22.0004, 18.7272]

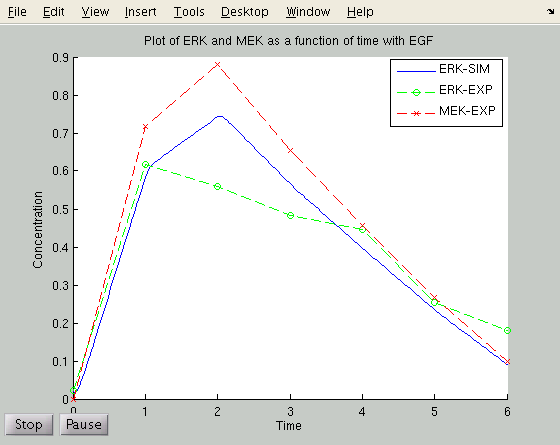
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 5.4514 | 4.5563 | 2.4979 |
| 10 | 10.5698 | 9.0774 | 2.2533 |
| 15 | 15.5024 | 13.2883 | 2.2216 |
| 20 | 22.0004 | 18.7272 | 2.2149 |
| 25 | 27.0102 | 22.7655 | 2.2197 |
| 30 | 32.0215 | 27.0117 | 2.2268 |
| 35 | 38.1266 | 31.8333 | 2.2273 |
| 40 | 43.8398 | 36.3672 | 2.2303 |
| 45 | 48.4724 | 40.2970 | 2.2330 |
| 50 | 54.7534 | 45.3271 | 2.2315 |
| 55 | 60.3515 | 49.9027 | 2.2322 |
| 60 | 65.6898 | 54.2175 | 2.2347 |
| 65 | 72.0962 | 59.3388 | 2.2322 |
| 70 | 76.3549 | 62.8445 | 2.2344 |
| 75 | 84.1333 | 69.0088 | 2.2337 |
| 80 | 87.0991 | 71.4873 | 2.2336 |
| 85 | 91.8440 | 75.2466 | 2.2363 |
| 90 | 97.6344 | 80.1497 | 2.2359 |
| 95 | 103.6550 | 84.8236 | 2.2356 |
| 100 | 110.2490 | 90.2637 | 2.2353 |
| 105 | 113.9440 | 93.3157 | 2.2356 |
| 110 | 117.1006 | 95.8418 | 2.2361 |
| 115 | 126.3751 | 103.4523 | 2.2359 |
| 120 | 130.4919 | 106.8003 | 2.2380 |
| 125 | 135.6277 | 110.9772 | 2.2372 |

Γράφημα για x = [22.0004, 18.7272]

Σύγκλιση

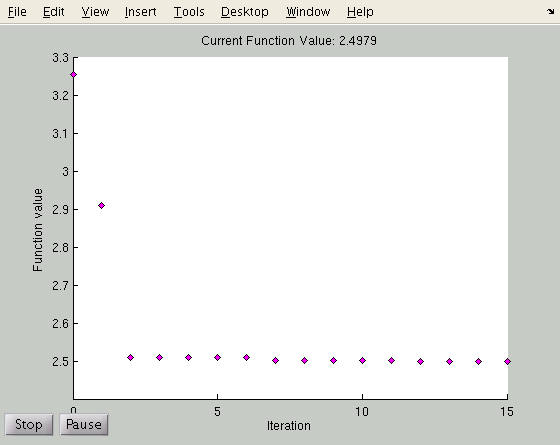


Λύση

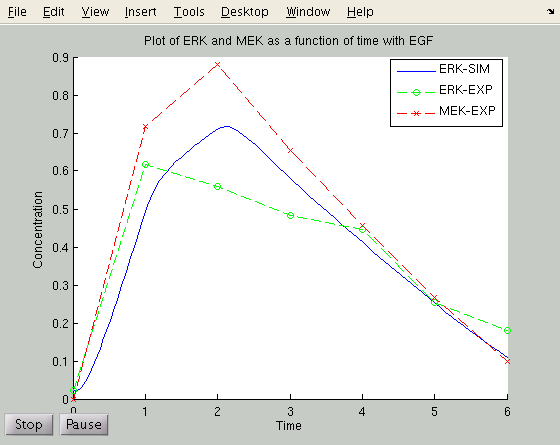


Γράφημα για x = [5.4514, 4.5563]

Σύγκλιση

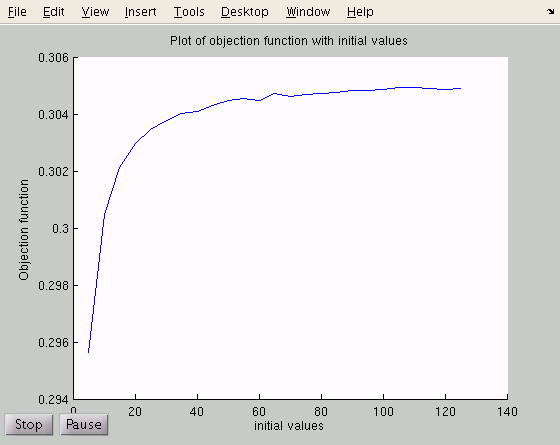


Λύση



**Inhibitor MEK-PI3K**

Interior-point

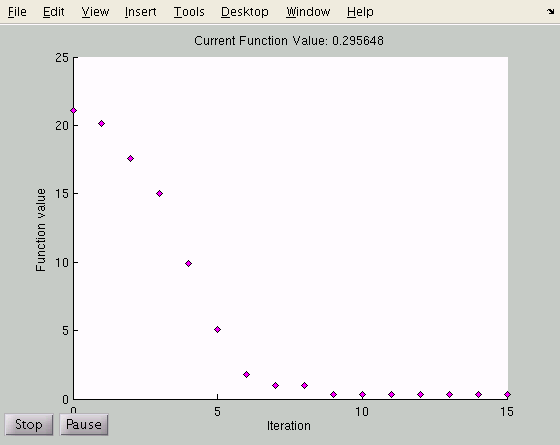


Min(f) = 0.2956, i = 1, xo = [5,5], xopt = [9.2140, 0.2508]

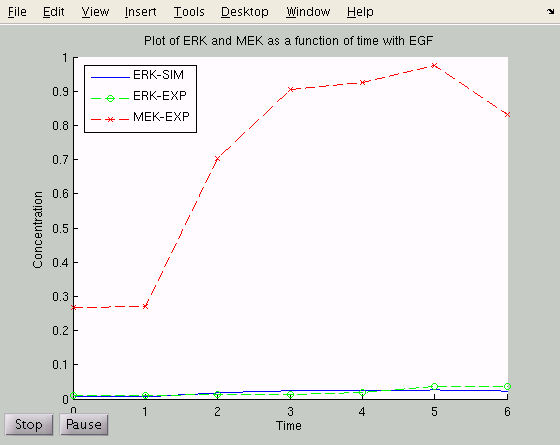
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 9.2140 | 0.2508 | 0.2956 |
| 10 | 18.4281 | 0.5016 | 0.3005 |
| 15 | 27.6421 | 0.7524 | 0.3021 |
| 20 | 36.8561 | 1.0032 | 0.3030 |
| 25 | 46.0702 | 1.2540 | 0.3034 |
| 30 | 55.2842 | 1.5048 | 0.3038 |
| 35 | 64.4982 | 1.7556 | 0.3040 |
| 40 | 73.7123 | 2.0063 | 0.3041 |
| 45 | 82.9263 | 2.2571 | 0.3043 |
| 50 | 92.1404 | 2.5079 | 0.3045 |
| 55 | 101.3544 | 2.7587 | 0.3045 |
| 60 | 110.5684 | 3.0095 | 0.3045 |
| 65 | 119.7825 | 3.2603 | 0.3047 |
| 70 | 128.9965 | 3.5111 | 0.3046 |
| 75 | 138.2105 | 3.7619 | 0.3047 |
| 80 | 147.4246 | 4.0127 | 0.3047 |
| 85 | 156.6386 | 4.2635 | 0.3048 |
| 90 | 165.8526 | 4.5143 | 0.3048 |
| 95 | 175.0667 | 4.7651 | 0.3048 |
| 100 | 184.2807 | 5.0159 | 0.3049 |
| 105 | 193.4947 | 5.2667 | 0.3049 |
| 110 | 202.7088 | 5.5175 | 0.3049 |
| 115 | 211.9228 | 5.7682 | 0.3049 |
| 120 | 221.1368 | 6.0190 | 0.3049 |
| 125 | 230.3509 | 6.2698 | 0.3049 |

Γράφημα για x = [9.2140, 0.2508]

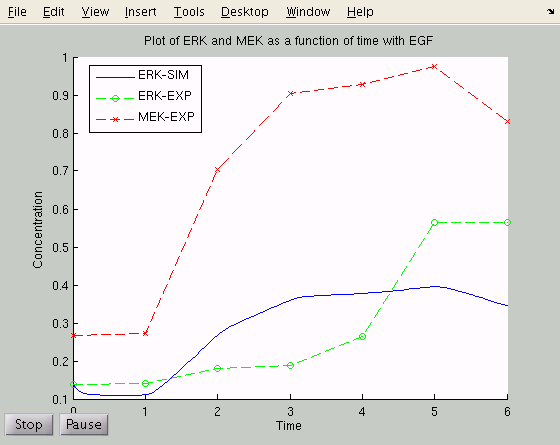
Σύγκλιση



Λύση

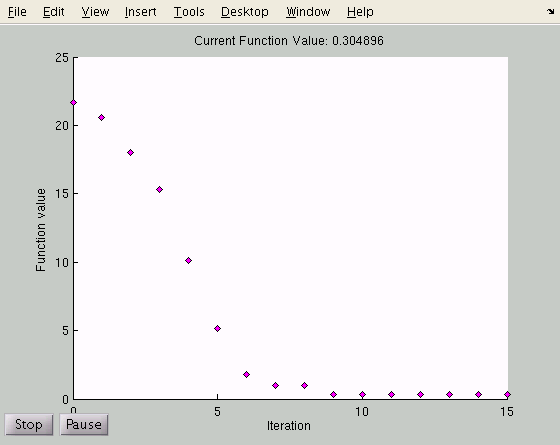


ERK\*15 για να φαίνεται

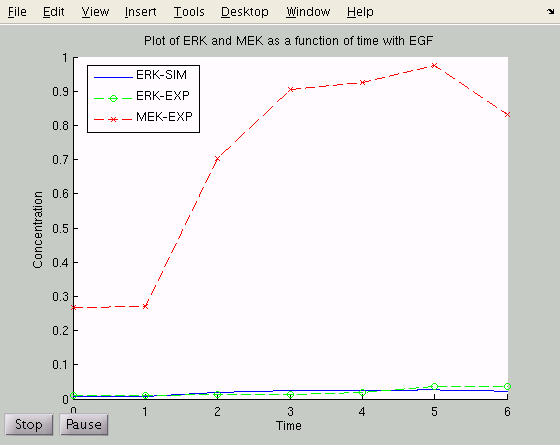


Γράφημα για [230.3509, 6.2698] για αντικειμενική 0.304896

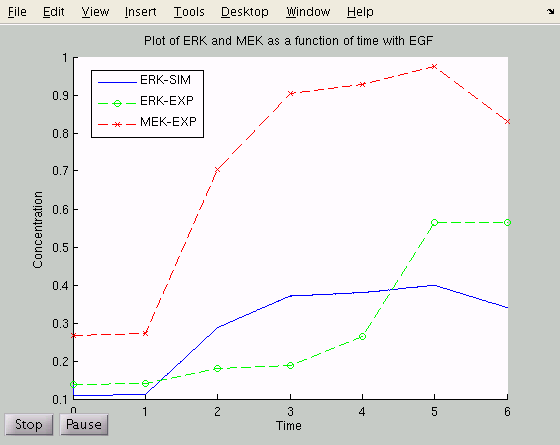
Σύγκλιση



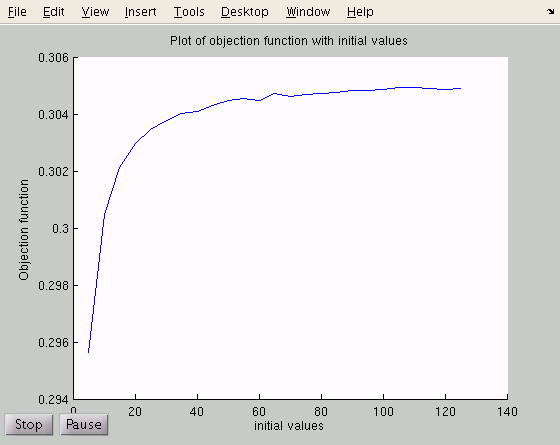
Λύση



ERK\*15 για να φαίνεται



SQP

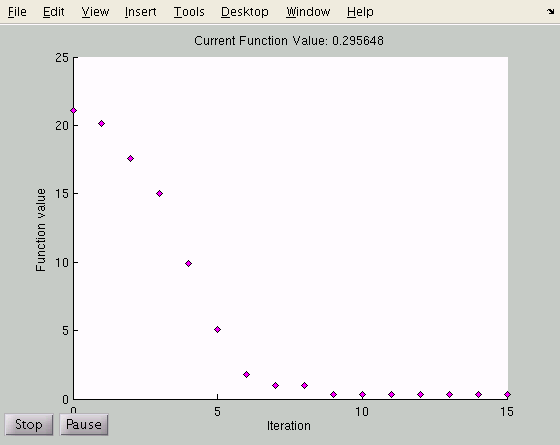


Min(f) = 0.2956, i = 1, xo = [5,5], xopt = [9.2140, 0.2508]

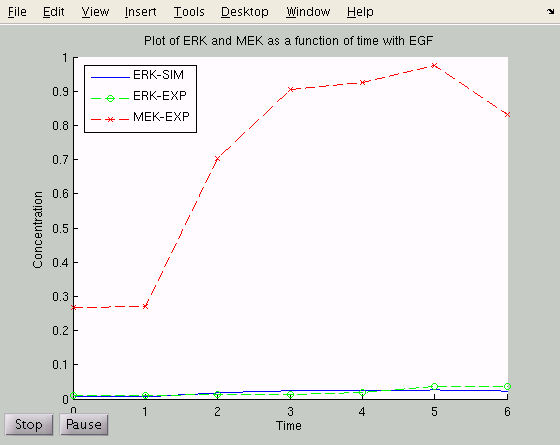
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 9.2140 | 0.2508 | 0.2956 |
| 10 | 18.4281 | 0.5016 | 0.3005 |
| 15 | 27.6421 | 0.7524 | 0.3021 |
| 20 | 36.8561 | 1.0032 | 0.3030 |
| 25 | 46.0702 | 1.2540 | 0.3034 |
| 30 | 55.2842 | 1.5048 | 0.3038 |
| 35 | 64.4982 | 1.7556 | 0.3040 |
| 40 | 73.7123 | 2.0063 | 0.3041 |
| 45 | 82.9263 | 2.2571 | 0.3043 |
| 50 | 92.1404 | 2.5079 | 0.3045 |
| 55 | 101.3544 | 2.7587 | 0.3045 |
| 60 | 110.5684 | 3.0095 | 0.3045 |
| 65 | 119.7825 | 3.2603 | 0.3047 |
| 70 | 128.9965 | 3.5111 | 0.3046 |
| 75 | 138.2105 | 3.7619 | 0.3047 |
| 80 | 147.4246 | 4.0127 | 0.3047 |
| 85 | 156.6386 | 4.2635 | 0.3048 |
| 90 | 165.8526 | 4.5143 | 0.3048 |
| 95 | 175.0667 | 4.7651 | 0.3048 |
| 100 | 184.2807 | 5.0159 | 0.3049 |
| 105 | 193.4947 | 5.2667 | 0.3049 |
| 110 | 202.7088 | 5.5175 | 0.3049 |
| 115 | 211.9228 | 5.7682 | 0.3049 |
| 120 | 221.1368 | 6.0190 | 0.3049 |
| 125 | 230.3509 | 6.2698 | 0.3049 |

Γράφημα για x = [9.2140, 0.2508]

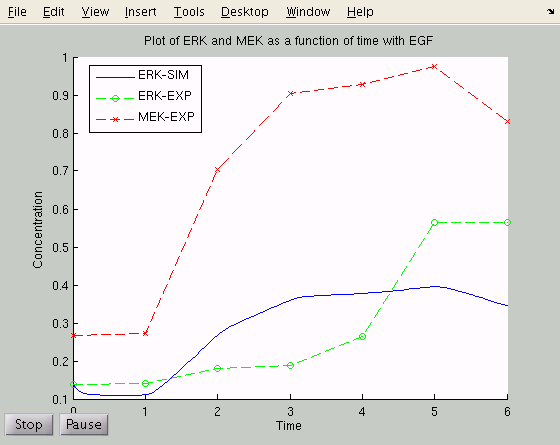
Σύγκλιση



Λύση

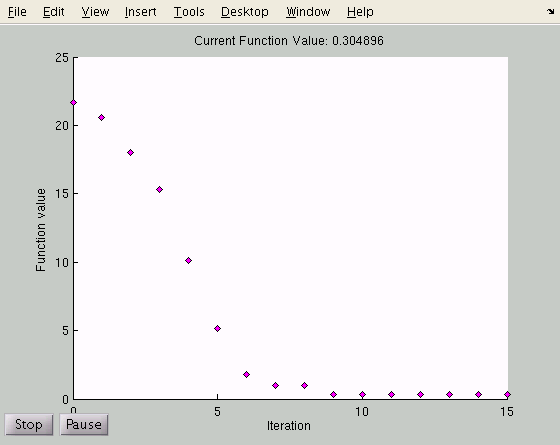


ERK\*15 για να φαίνεται

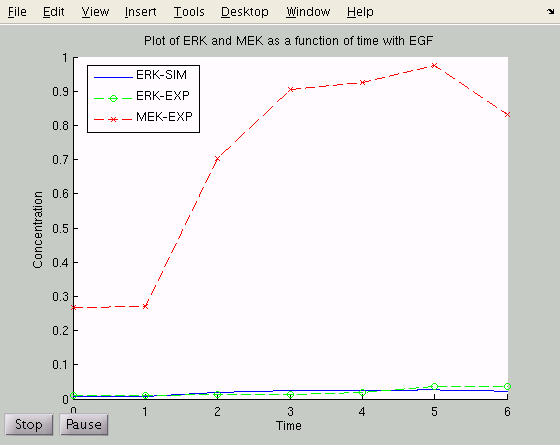


Γράφημα για x = [230.3509, 6.2698] για αντικειμενική 0.304896

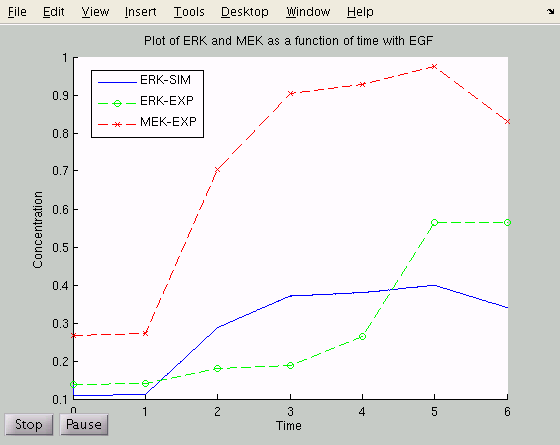
Σύγκλιση



Λύση

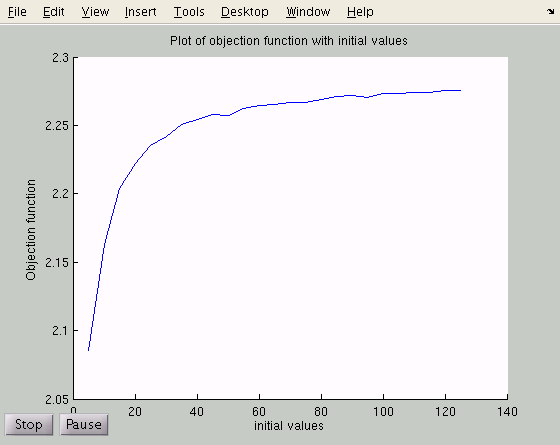


ERK\*15 για να φαίνεται



**Inhibitor EGF**

Interior-point

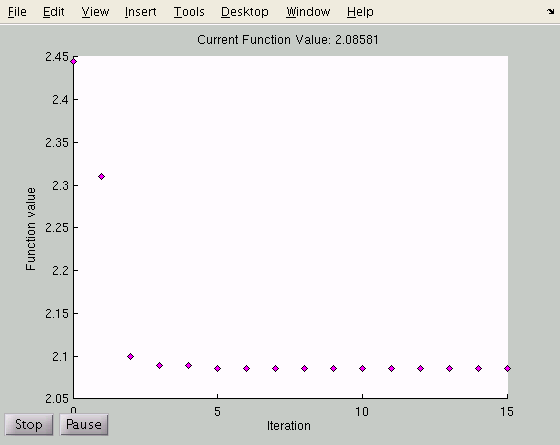


Min(f) = 2.0858, i = 1, xo = [5,5], xopt = [4.4378, 5.5071]

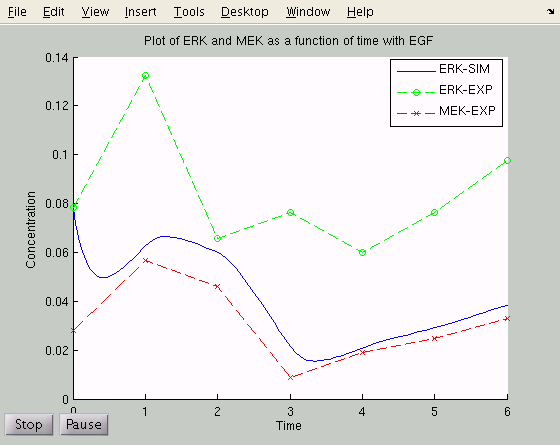
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 4.4378 | 5.5071 | 2.0858 |
| 10 | 8.7091 | 11.6164 | 2.1630 |
| 15 | 12.6533 | 16.8853 | 2.2035 |
| 20 | 17.1440 | 22.7178 | 2.2218 |
| 25 | 20.9119 | 27.6636 | 2.2350 |
| 30 | 25.8120 | 34.1162 | 2.2420 |
| 35 | 29.7500 | 39.3750 | 2.2506 |
| 40 | 33.8223 | 44.5508 | 2.2540 |
| 45 | 38.2654 | 50.4800 | 2.2577 |
| 50 | 42.4146 | 55.9619 | 2.2571 |
| 55 | 48.0182 | 63.3734 | 2.2625 |
| 60 | 50.8403 | 67.0635 | 2.2643 |
| 65 | 56.2117 | 74.1851 | 2.2653 |
| 70 | 61.8687 | 81.4639 | 2.2669 |
| 75 | 62.7173 | 82.6611 | 2.2671 |
| 80 | 67.7109 | 89.2969 | 2.2689 |
| 85 | 73.6611 | 97.1191 | 2.2715 |
| 90 | 77.6667 | 102.1421 | 2.2721 |
| 95 | 81.7450 | 107.7888 | 2.2706 |
| 100 | 84.5410 | 111.1133 | 2.2732 |
| 105 | 92.0391 | 121.0781 | 2.2734 |
| 110 | 95.2904 | 125.6524 | 2.2742 |
| 115 | 99.0773 | 130.7381 | 2.2741 |
| 120 | 102.4788 | 135.1871 | 2.2754 |
| 125 | 107.2205 | 141.2964 | 2.2752 |

Γράφημα για x = [4.4378, 5.5071]

Σύγκλιση

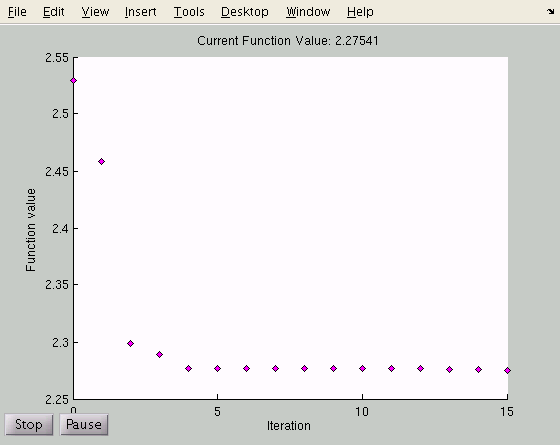


Λύση

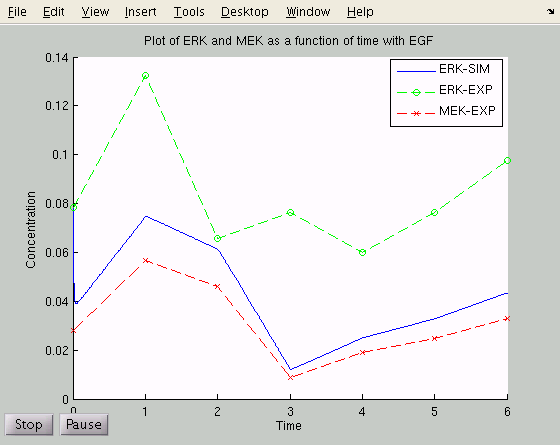


Γράφημα για x = [102.4788, 135.1871]

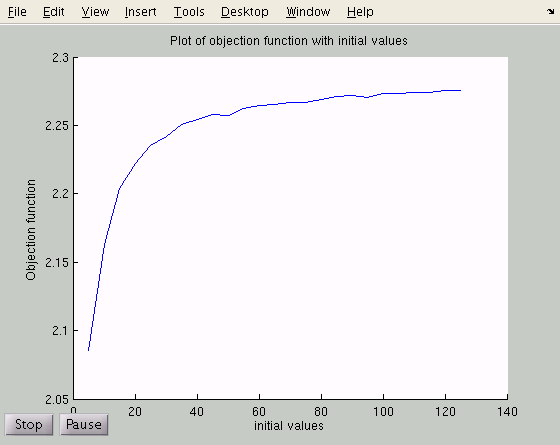
Σύγκλιση



Λύση



SQP

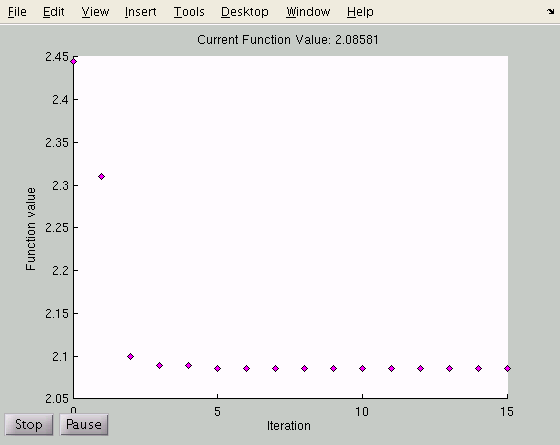


Min(f) = 2.0858, i = 1, xo = [5,5], xopt = [4.4378, 5.5071]

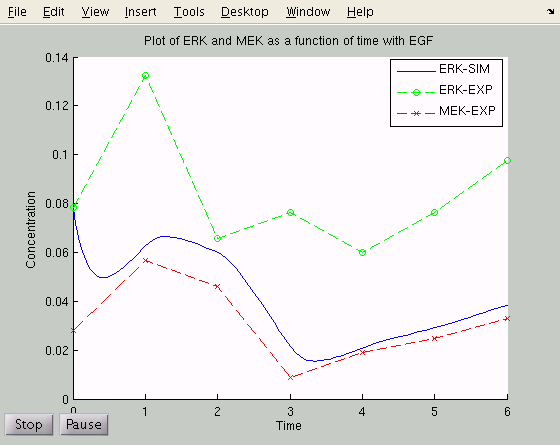
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **f** |
| 5 | 4.4378 | 5.5071 | 2.0858 |
| 10 | 8.7091 | 11.6164 | 2.1630 |
| 15 | 12.6533 | 16.8853 | 2.2035 |
| 20 | 17.1440 | 22.7178 | 2.2218 |
| 25 | 20.9119 | 27.6636 | 2.2350 |
| 30 | 25.8120 | 34.1162 | 2.2420 |
| 35 | 29.7500 | 39.3750 | 2.2506 |
| 40 | 33.8223 | 44.5508 | 2.2540 |
| 45 | 38.2654 | 50.4800 | 2.2577 |
| 50 | 42.4146 | 55.9619 | 2.2571 |
| 55 | 48.0182 | 63.3734 | 2.2625 |
| 60 | 50.8403 | 67.0635 | 2.2643 |
| 65 | 56.2117 | 74.1851 | 2.2653 |
| 70 | 61.8687 | 81.4639 | 2.2669 |
| 75 | 62.7173 | 82.6611 | 2.2671 |
| 80 | 67.7109 | 89.2969 | 2.2689 |
| 85 | 73.6611 | 97.1191 | 2.2715 |
| 90 | 77.6667 | 102.1421 | 2.2721 |
| 95 | 81.7450 | 107.7888 | 2.2706 |
| 100 | 84.5410 | 111.1133 | 2.2732 |
| 105 | 92.0391 | 121.0781 | 2.2734 |
| 110 | 95.2904 | 125.6524 | 2.2742 |
| 115 | 99.0773 | 130.7381 | 2.2741 |
| 120 | 102.4788 | 135.1871 | 2.2754 |
| 125 | 107.2205 | 141.2964 | 2.2752 |

Γράφημα για x = [4.4378, 5.5071]

Σύγκλιση

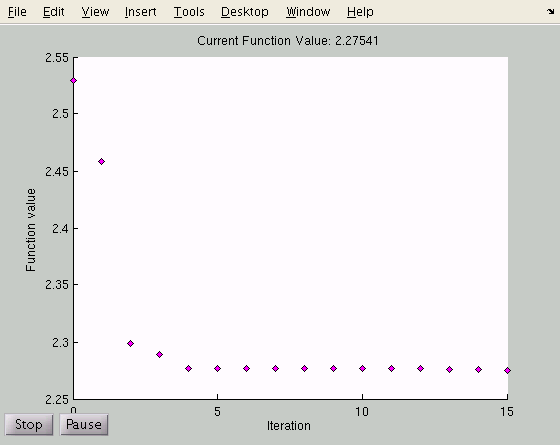


Λύση

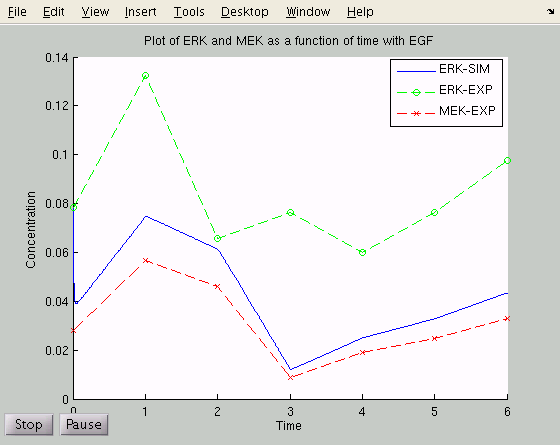


Γράφημα για x = [102.4788, 135.1871]

Σύγκλιση

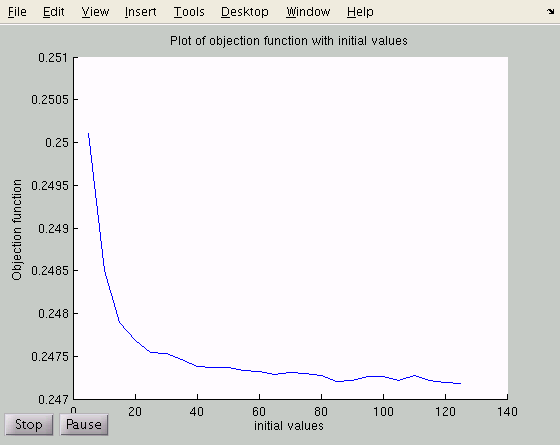


Λύση



**Inhibitor EGF-MEK-PI3K**

Interior-point

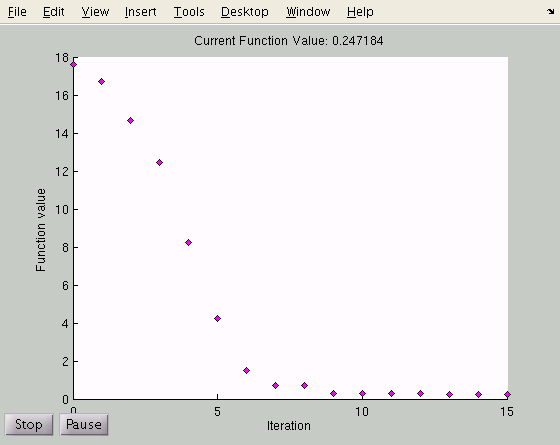


Min(f) = 0.2472(0.247184), i = 25, xo = [125,125], xopt = [233.1296, 5.3143]

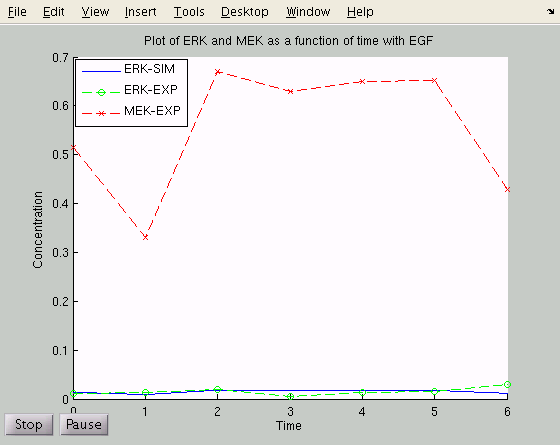
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **F** |
| 5 | 9.3252 | 0.2126 | 0.2501 |
| 10 | 18.6504 | 0.4251 | 0.2485 |
| 15 | 27.9756 | 0.6377 | 0.2479 |
| 20 | 37.3007 | 0.8503 | 0.2477 |
| 25 | 46.6259 | 1.0629 | 0.2475 |
| 30 | 55.9511 | 1.2754 | 0.2475 |
| 35 | 65.2763 | 1.4880 | 0.2475 |
| 40 | 74.6015 | 1.7006 | 0.2474 |
| 45 | 83.9267 | 1.9131 | 0.2474 |
| 50 | 93.2518 | 2.1257 | 0.2474 |
| 55 | 102.5770 | 2.3383 | 0.2473 |
| 60 | 111.9022 | 2.5508 | 0.2473 |
| 65 | 121.2274 | 2.7634 | 0.2473 |
| 70 | 130.5526 | 2.9760 | 0.2473 |
| 75 | 139.8778 | 3.1886 | 0.2473 |
| 80 | 149.2029 | 3.4011 | 0.2473 |
| 85 | 158.5281 | 3.6137 | 0.2472 |
| 90 | 167.8533 | 3.8263 | 0.2472 |
| 95 | 177.1785 | 4.0388 | 0.2473 |
| 100 | 186.5037 | 4.2514 | 0.2473 |
| 105 | 195.8289 | 4.4640 | 0.2472 |
| 110 | 205.1540 | 4.6765 | 0.2473 |
| 115 | 214.4792 | 4.8891 | 0.2472 |
| 120 | 223.8044 | 5.1017 | 0.2472 |
| 125 | 233.1296 | 5.3143 | 0.2472 |
| 130 | 242.4548 | 5.5268 | 0.2472 |
| 135 | 251.7800 | 5.7384 | 0.2472 |

Γράφημα για x = [233.1296, 5.3143]

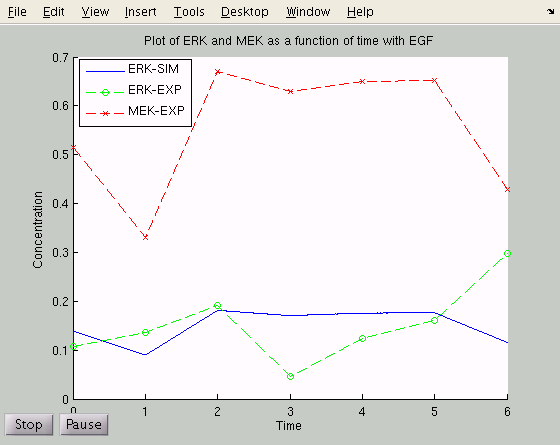
Σύγκλιση



Λύση

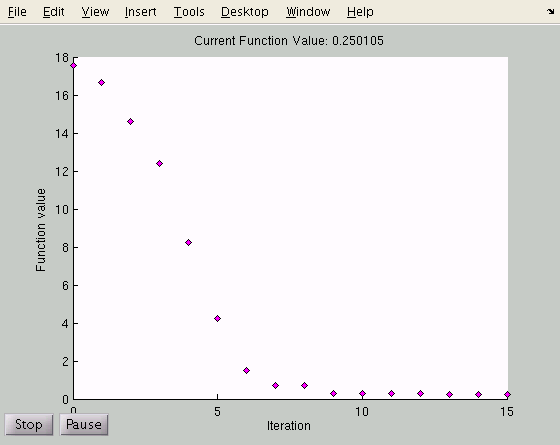


ERK\*10 για να φαίνεται

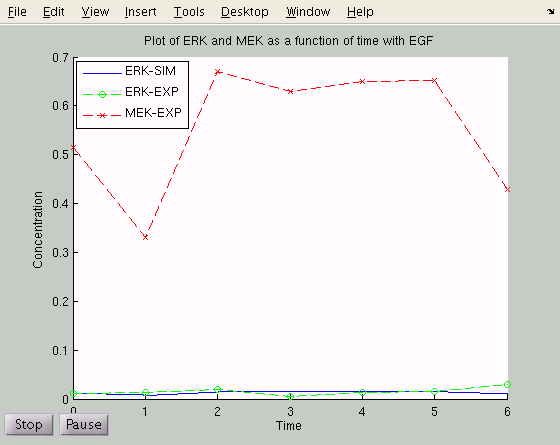


Γράφημα για x = [9.3252, 0.2126]

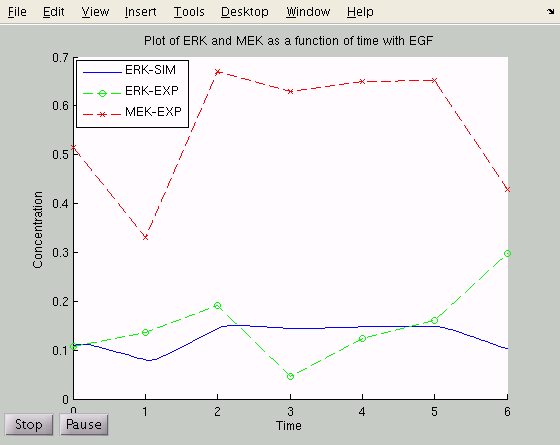
Σύγκλιση



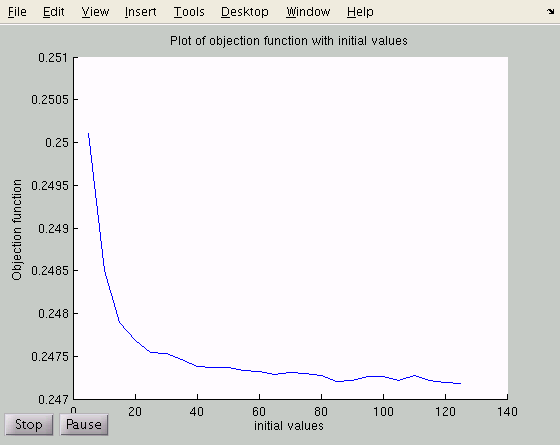
Λύση



ERK\*10 για να φαίνεται



SQP

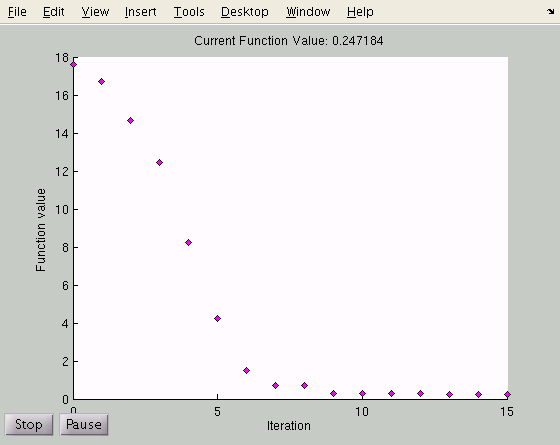


Min(f) = 0.2472(0.247184), i = 25, xo = [125,125], xopt = [233.1296, 5.3143]

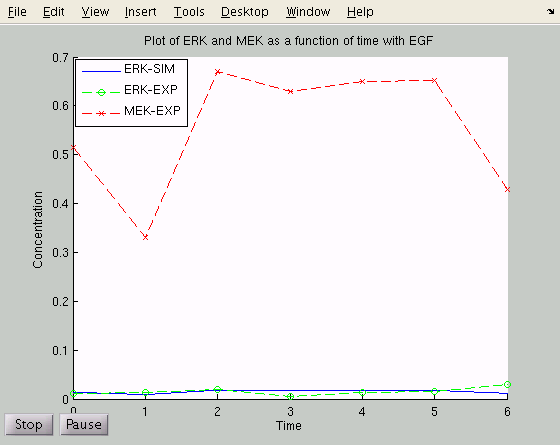
|  |  |  |  |
| --- | --- | --- | --- |
| **X\_0** | **X\_1** | **X\_2** | **F** |
| 5 | 9.3252 | 0.2126 | 0.2501 |
| 10 | 18.6504 | 0.4251 | 0.2485 |
| 15 | 27.9756 | 0.6377 | 0.2479 |
| 20 | 37.3007 | 0.8503 | 0.2477 |
| 25 | 46.6259 | 1.0629 | 0.2475 |
| 30 | 55.9511 | 1.2754 | 0.2475 |
| 35 | 65.2763 | 1.4880 | 0.2475 |
| 40 | 74.6015 | 1.7006 | 0.2474 |
| 45 | 83.9267 | 1.9131 | 0.2474 |
| 50 | 93.2518 | 2.1257 | 0.2474 |
| 55 | 102.5770 | 2.3383 | 0.2473 |
| 60 | 111.9022 | 2.5508 | 0.2473 |
| 65 | 121.2274 | 2.7634 | 0.2473 |
| 70 | 130.5526 | 2.9760 | 0.2473 |
| 75 | 139.8778 | 3.1886 | 0.2473 |
| 80 | 149.2029 | 3.4011 | 0.2473 |
| 85 | 158.5281 | 3.6137 | 0.2472 |
| 90 | 167.8533 | 3.8263 | 0.2472 |
| 95 | 177.1785 | 4.0388 | 0.2473 |
| 100 | 186.5037 | 4.2514 | 0.2473 |
| 105 | 195.8289 | 4.4640 | 0.2472 |
| 110 | 205.1540 | 4.6765 | 0.2473 |
| 115 | 214.4792 | 4.8891 | 0.2472 |
| 120 | 223.8044 | 5.1017 | 0.2472 |
| 125 | 233.1296 | 5.3143 | 0.2472 |
| 130 | 242.4548 | 5.5268 | 0.2472 |
| 135 | 251.7800 | 5.7384 | 0.2472 |

Γράφημα για x = [233.1296, 5.3143]

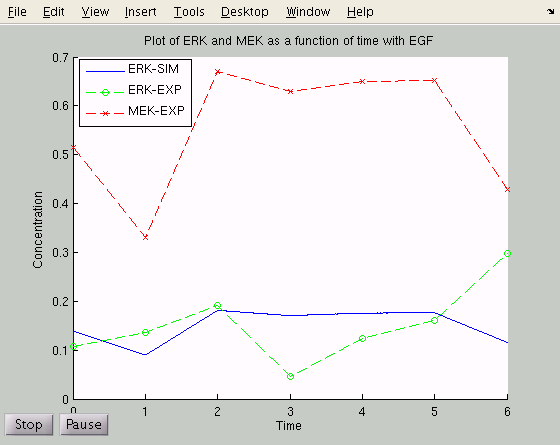
Σύγκλιση



Λύση

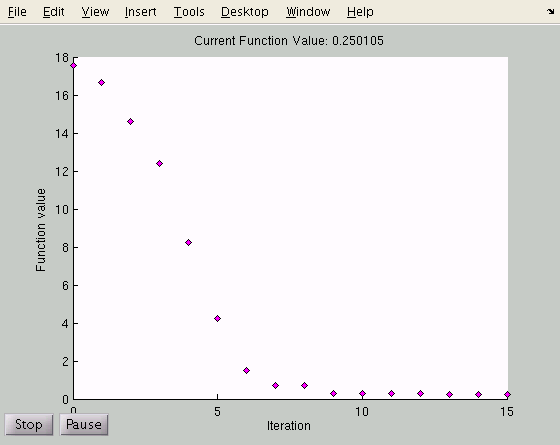


ERK\*10 για να φαίνεται

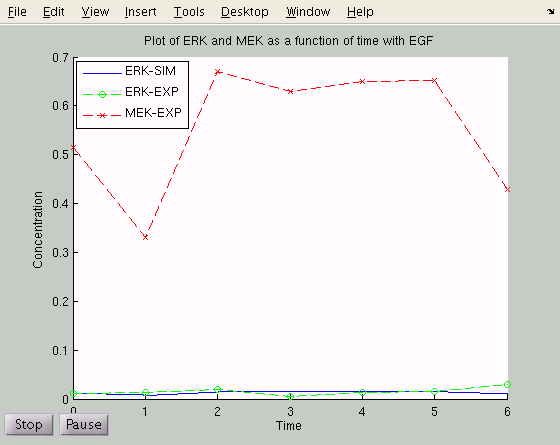


Γράφημα για x = [9.3252, 0.2126]

Σύγκλιση



Λύση



ERK\*10 για να φαίνεται

